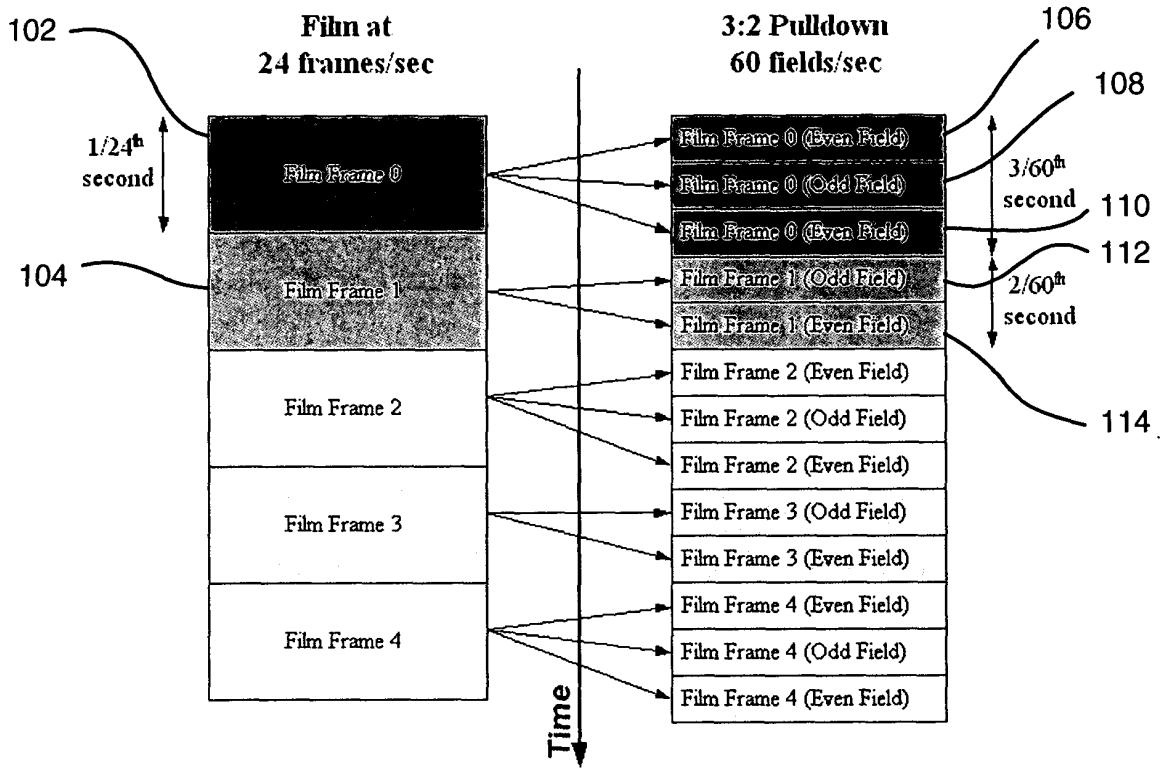

102
Film at
24 frames/sec
3:2 Pulldown
60 fields/sec
106
108
1/24th
second
Film Frame 0
Film Frame 0 (Even Field)
Film Frame 0 (Odd Field)
Film Frame 0 (Even Field)
3/60th
second
110
104
Film Frame 1
Film Frame 1 (Odd Field)
Film Frame 1 (Even Field)
112
2/60th
second
Film Frame 2
Film Frame 2 (Even Field)
Film Frame 2 (Odd Field)
Film Frame 2 (Even Field)
114
Film Frame 3
Film Frame 3 (Odd Field)
Film Frame 3 (Even Field)
Film Frame 4
Film Frame 4 (Even Field)
Film Frame 4 (Odd Field)
Film Frame 4 (Even Field)
Time

FIG. 1

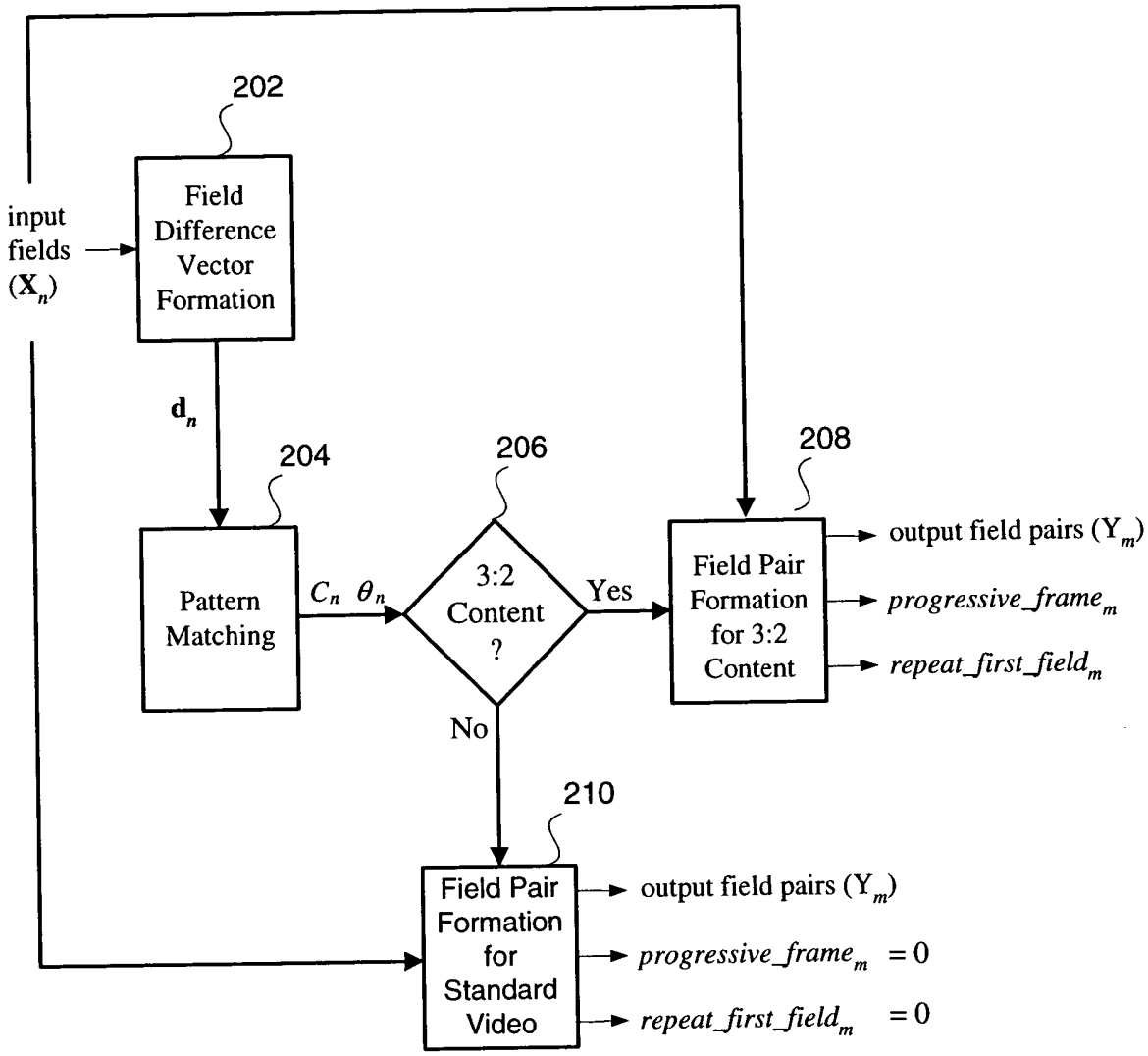

202
input fields ($\mathbf{X}_n$)
Field Difference Vector Formation
$\mathbf{d}_n$
204
Pattern Matching
C_n θ_n
206
3:2 Content ?
Yes
No
208
Field Pair Formation for 3:2 Content
output field pairs (Y_m)
$progressive\_frame_m$
$repeat\_first\_field_m$
210
Field Pair Formation for Standard Video
output field pairs (Y_m)
$progressive\_frame_m = 0$
$repeat\_first\_field_m = 0$

FIG. 2

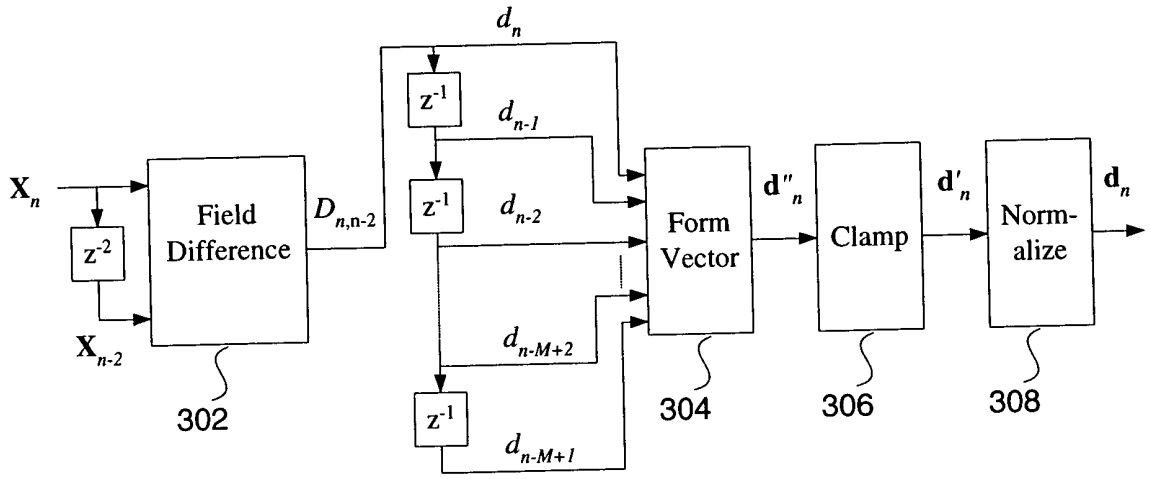

d_n
z^{-1}
d_{n-1}
X_n
z^{-2}
Field Difference
$D_{n,n-2}$
z^{-1}
d_{n-2}
Form Vector
$\mathbf{d}''_n$
Clamp
$\mathbf{d}'_n$
Norm-alize
$\mathbf{d}_n$
X_{n-2}
d_{n-M+2}
z^{-1}
d_{n-M+1}
302
304
306
308
202

FIG. 3

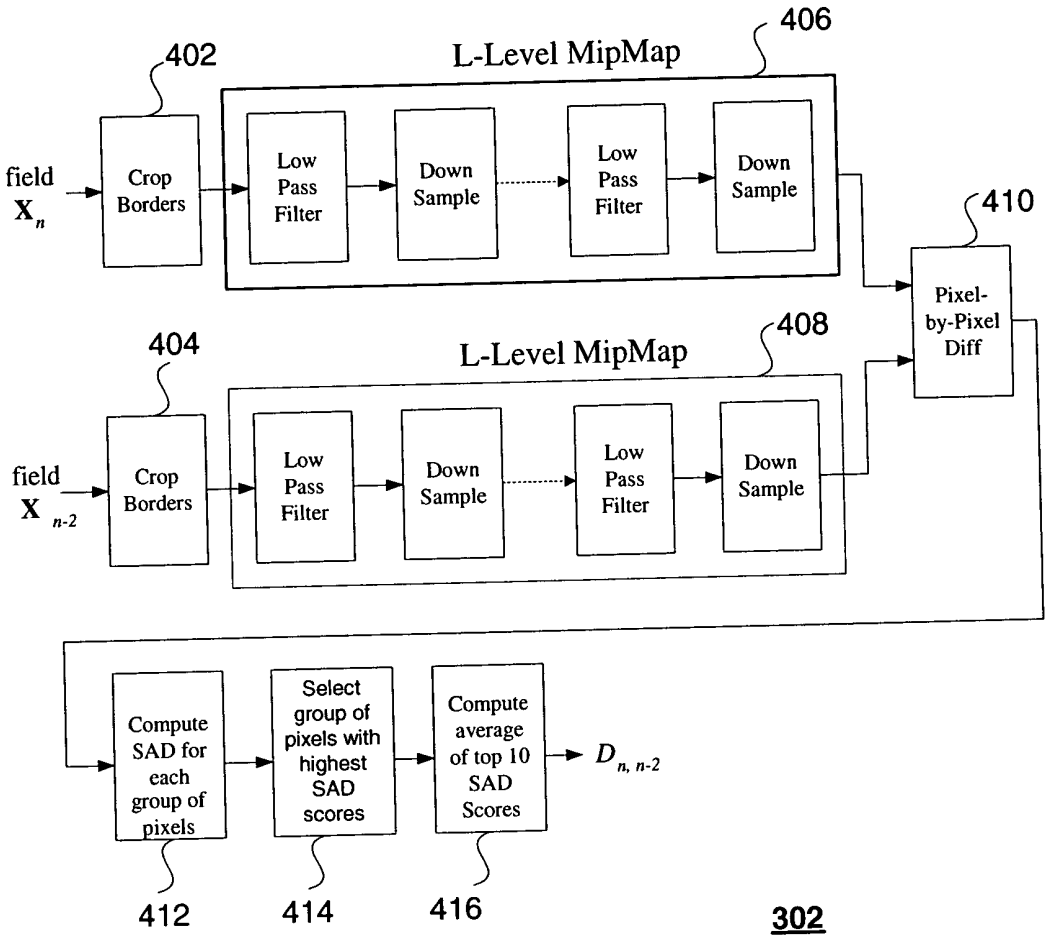
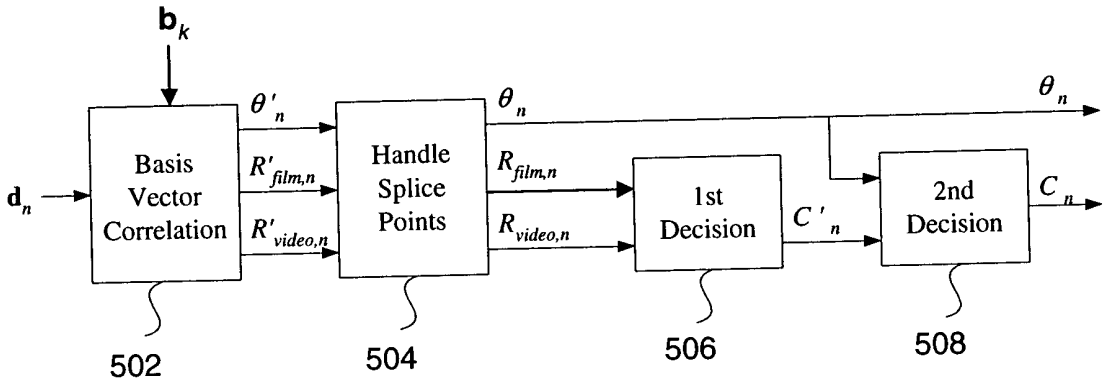

406
L-Level MipMap
402
field
X_n
Crop Borders
Low Pass Filter
Down Sample
Low Pass Filter
Down Sample
410
Pixel-by-Pixel Diff
404
L-Level MipMap
408
field
X_{n-2}
Crop Borders
Low Pass Filter
Down Sample
Low Pass Filter
Down Sample
Compute SAD for each group of pixels
Select group of pixels with highest SAD scores
Compute average of top 10 SAD Scores
$D_{n, n-2}$
412
414
416
302

FIG. 4


$\mathbf{b}_k$
$\mathbf{d}_n$
Basis Vector Correlation
θ'_n
$R'_{film,n}$
$R'_{video,n}$
Handle Splice Points
θ_n
$R_{film,n}$
$R_{video,n}$
1st Decision
C'_n
2nd Decision
C_n
θ_n
502
504
506
508

204

FIG. 5

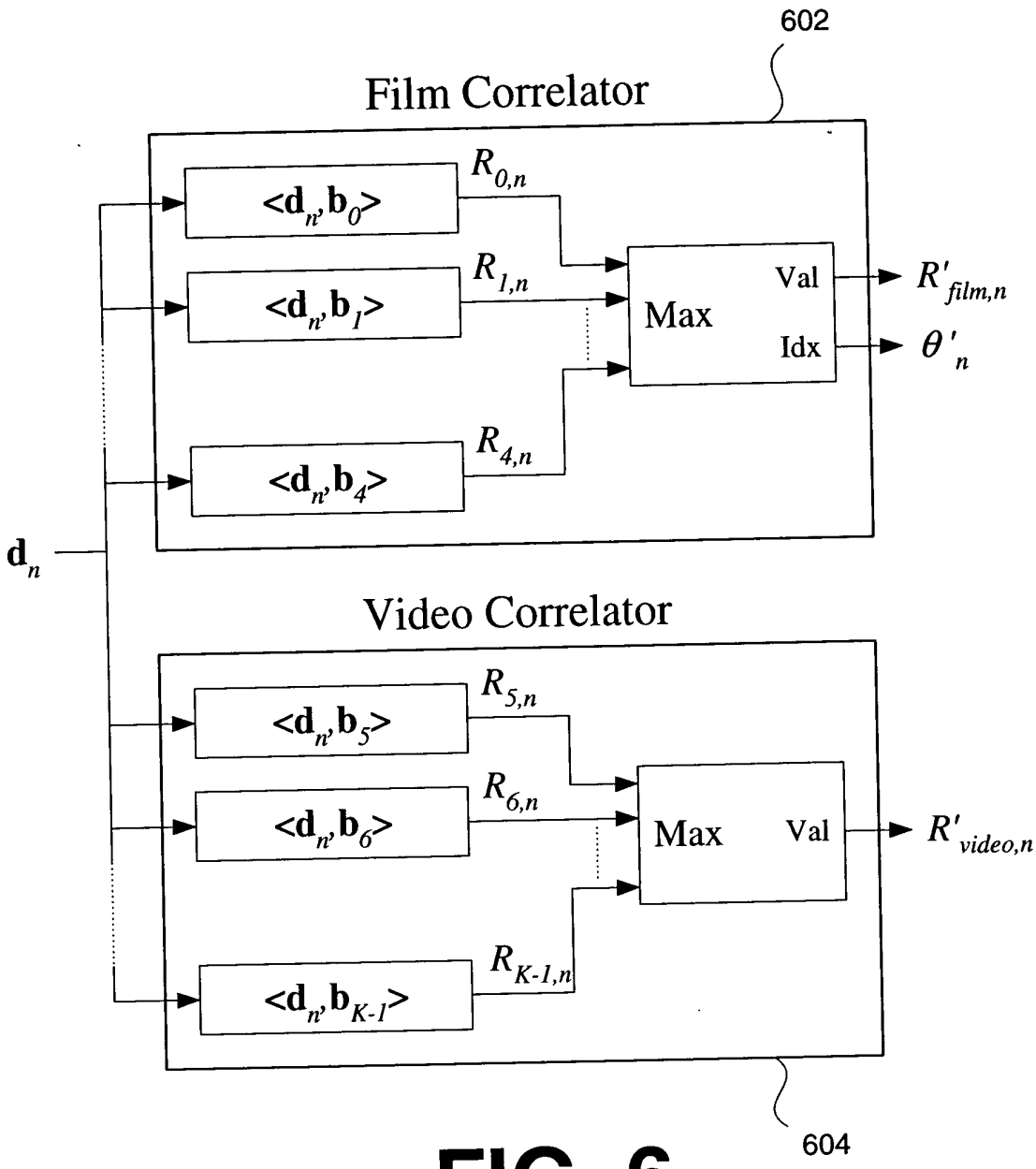
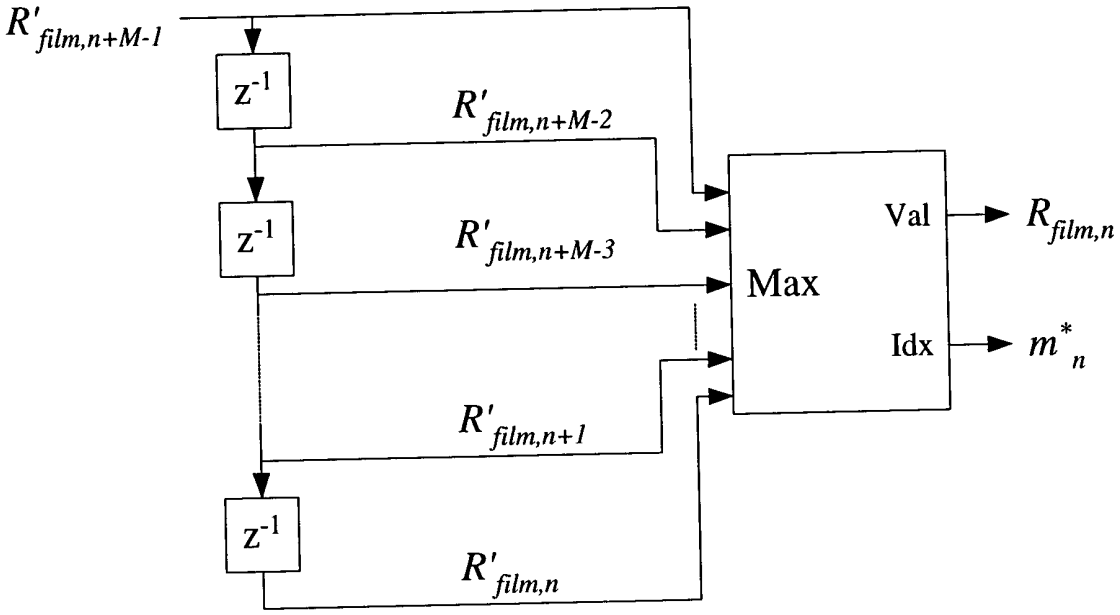

602
Film Correlator
<d_n, b_0>
<d_n, b_1>
<d_n, b_4>
R_0,n
R_1,n
R_4,n
Max
Val
Idx
R'_film,n
θ'_n
d_n
Video Correlator
<d_n, b_5>
<d_n, b_6>
<d_n, b_K-1>
R_5,n
R_6,n
R_K-1,n
Max
Val
R'_video,n
604

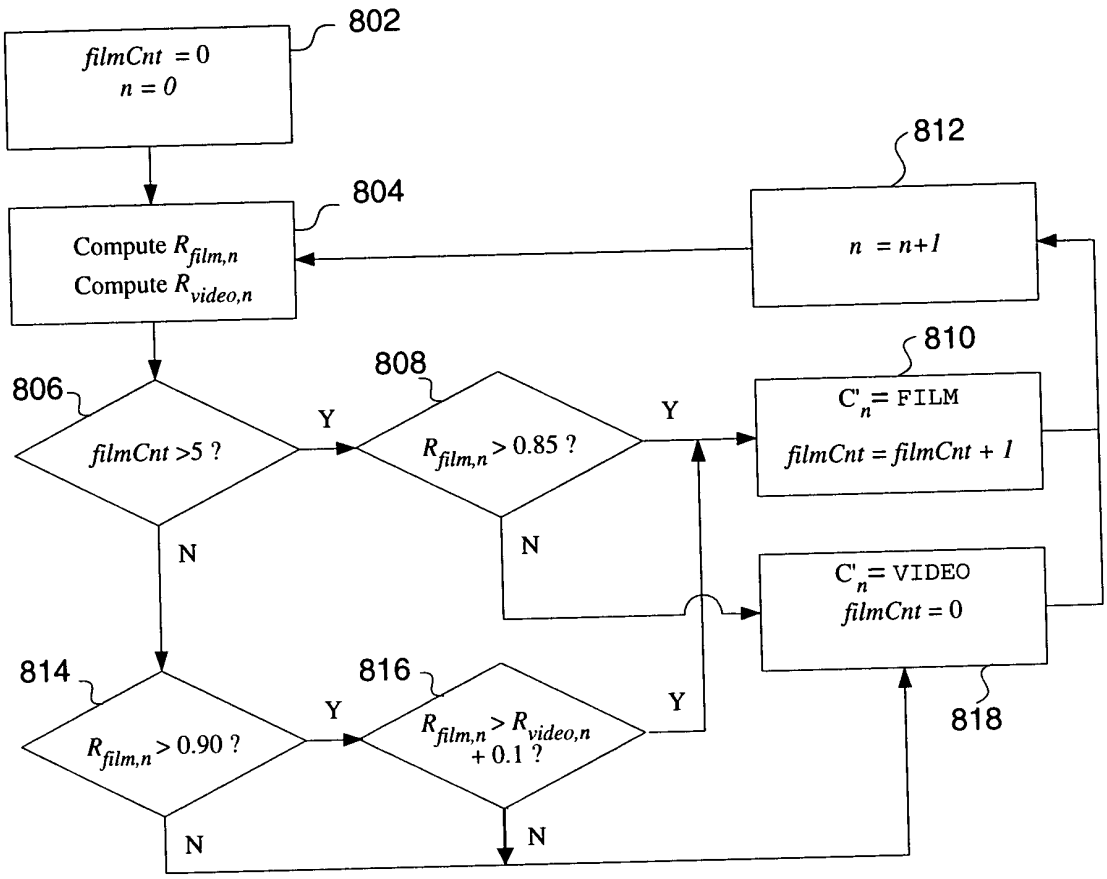
FIG. 6

502


$R'_{film,n+M-1}$
z^{-1}
$R'_{film,n+M-2}$
z^{-1}
$R'_{film,n+M-3}$
Max
Val
$R_{film,n}$
Idx
m^*_n
$R'_{film,n+1}$
z^{-1}
$R'_{film,n}$

504

FIG. 7


802
filmCnt = 0
n = 0
804
Compute $R_{film,n}$
Compute $R_{video,n}$
812
n = n+1
806
filmCnt >5 ?
Y
808
$R_{film,n}$ > 0.85 ?
Y
810
C'n = FILM
filmCnt = filmCnt + 1
N
N
C'n = VIDEO
filmCnt = 0
814
$R_{film,n}$ > 0.90 ?
Y
816
$R_{film,n}$ > $R_{video,n}$ + 0.1 ?
Y
818
N
N

506

FIG. 8

902 904 906

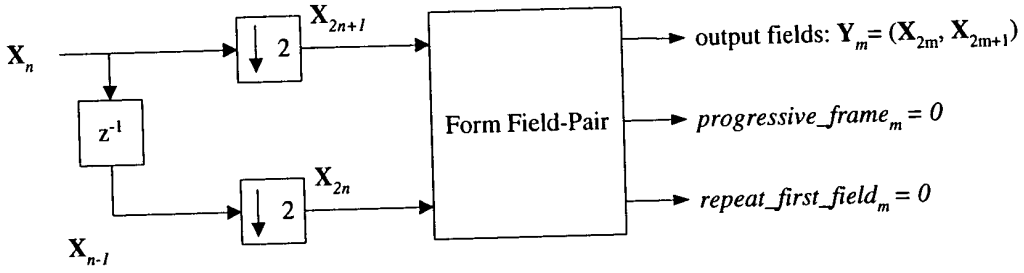
Input Field Sequence $\{X_n\}$	Observed 3:2 Phase $\{\theta_n\}$	Field-Pair Formation
n: 01234567890123456… Xn: aAbBbCcDdDeEfFfGg… Note: no splice point	----0----0----0--…	m: 0 1 2 3 4 5 6 Ym: (X0,X1)(X2,X3)(X5,X6)(X7,X8)(X0,X1)(X2,X3)(X5,X6) PF: 1 1 1 1 1 1 1 RFF: 0 1 0 1 0 1 0
n: 0123456789… Xn: aAbBbCcDd…	----0--0--…	m: 0 1 2 3 Ym: (X0,X1)(X2,X3)(X5,X6)(X8,X9) PF: 1 1 1 1 RFF: 0 1 1 0
n: 01234567890… Xn: aAbBbCdDdEe… Xn: aAbBbCdDdEe…	----0---0--… —	m: 0 1 2 3 Ym: (X0,X1)(X2,X3)(X6,X7)(X9,X0) PF: 1 1 1 1 RFF: 0 1 1 1
n: 012345678901… Xn: aAbBbCcDdDeE… Xn: aAbBbCdEeEfF… Xn: aAbBbCcDdDeE…	----0----0--…	m: 0 1 2 3 4 Ym: (X0,X1)(X2,X3)(X5,X6)(X7,X8)(X0,X1) PF: 1 1 * 1 1 RFF: 0 1 0 1 0
n: 0123456789012… Xn: aAbBbCdDeEeFf… Xn: aAbBbCdDeEeFf… Xn: aAbBbCcDeEeFf… Xn: aAbBbCcDeEeFf…	----0-----0--…	m: 0 1 2 3 4 Ym: (X0,X1)(X2,X3)(X6,X7)(X8,X9)(X1,X2) PF: 1 1 0 1 1 RFF: 0 1 1 1 0
n: 01234567890123… Xn: aAbBbCcDdEeEfF… Xn: aAbBbCdEeFfFgG… Xn: aAbBbCcDdEeEfF… Xn: aAbBbCcDeFfFgG… Xn: aAbBbCcDdEeEfF…	----0------0--…	m: 0 1 2 3 4 5 Ym: (X0,X1)(X2,X3)(X5,X6)(X7,X8)(X9,X0)(X2,X3) PF: 1 1 * * 1 1 RFF: 0 1 0 0 1 0
n: 012345678901234… Xn: aAbBbCdDeEfFfGg… Xn: aAbBbCcDeEfFfGg… Xn: aAbBbCcDeEfFfGg… Xn: aAbBbCcDdEfFfGg…	----0-------0--…	m: 0 1 2 3 4 5 Ym: (X0,X1)(X2,X3)(X5,X6)(X8,X9)(X0,X1)(X3,X4) PF: 1 1 * 1 1 1 RFF: 0 1 0 1 1 0
n: 0123456789012345… Xn: aAbBbCcDdEeFfFgG… Xn: aAbBbCcDeFfGgGhH… Xn: aAbBbCcDdEeFfFgG…	----0--------0--…	m: 0 1 2 3 4 5 6 Ym: (X0,X1)(X2,X3)(X5,X6)(X7,X8)(X9,X0)(X1,X2)(X4,X5) PF: 1 1 1 * 1 1 1 RFF: 0 1 0 0 0 1 0
n: 01234567890123456… Xn: aAbBbCcDeEfFgGgHh… Xn: aAbBbCcDdFgGhHhIi…	----0---------0--…	m: 0 1 2 3 4 5 6 Ym: (X0,X1)(X2,X3)(X5,X6)(X7,X8)(X0,X1)(X2,X3)(X5,X6) PF: 1 1 1 * * 1 1 RFF: 0 1 0 0 1 1 0
n: 012345678901234567… Xn: aAbBbCcDdFfGgHhHiI…	----0----------0--…	m: 0 1 2 3 4 5 6 7 Ym: (X0,X1)(X2,X3)(X5,X6)(X7,X8)(X9,X0)(X1,X2)(X3,X4)(X6,X7) PF: 1 1 1 1 1 1 1 1 RFF: 0 1 0 0 0 0 1 0

Key

Symbol	Meaning
Xn	Input field sequence with field index n.
Ym	Output field-pair sequence with field-pair index m.
(Xj,Xk)	A field pair consisting of field Xj and Xk.
PF	The *progressive_frame* flag
RFF	The *repeat_first_field* flag.
*	Use the frame difference ($D_{n,n-1}$) to set the *progressive_frame* flag to 1 if the frame difference is small.
0	A telecine phase of zero.
-	A non-zero telecine phase.
aAbBb	First field sequence. Lower case and upper case letters of the same letter correspond to even and odd fields of a single film frame.
gGgHh	Second field sequence. Lower case and upper case letters of the same letter correspond to even and odd fields of a single film frame.

FIG. 9

208


X_n
2
X_{2n+1}
z^{-1}
2
X_{2n}
X_{n-1}
Form Field-Pair
output fields: $Y_m = (X_{2m}, X_{2m+1})$
$progressive\_frame_m = 0$
$repeat\_first\_field_m = 0$

210

FIG. 10

```
Init:

n = 1;
m = 0;

Start:

 Get C[n] and θ[n] from Pattern Matching Engine;
availableFields = m - n;

if (availableFields >= 2) {
    fieldOut0 = X[n];
    fieldOut1 = X[n-1];
    repeat_first_field = false;
    progressive_frame = false;

    if (C[n] == VIDEO) {
        m = m + 2;
    }
    else {
        if (availableFields == 3) {
            repeat_first_field = true;
            progressive_frame = true;

            if( θ[n-2] !=0 AND θ[n+1] != 0 AND θ[n+3] != 0) {
                fieldOut0 = X[n-1];
                fieldOut1 = X[n-2];
            }

            m = m + 3;
        }
        if (availableFields == 2) {
            if( θ[n-1] !=0 AND θ[n+1] != 0 AND θ[n+2] !=0 AND θ[n+4] != 0) {
                progressive_frame = true;
                m = m + 2;
            }
            else {
                n = n + 1;
                goto Start;
            }
        }
        if (C[n] == FILM_IN_TRANSITION) {
           if ((D(field0, field1) > threshold) OR ( θ[n-3] == 0 AND θ[n+3] == 0)) {
                progressive_frame = false;
            }

        Output( fieldOut0, fieldOut1, repeat_first_field, progressive_frame );
    }
}

n = n + 1;
goto Start;
```

FIG. 11